CBSE

GRAVITATION WS 1

Class 11 - Physics

1. The escape velocity from the earth is 11.2 km s^{-1}. The escape velocity from a planet having twice the radius and the same mean density as the earth is: **[1]**

   a) 11.2 km s^{-1}
   b) 22.4 km s^{-1}
   c) 5.5 km s^{-1}
   d) 15.5 km s^{-1}

2. A man waves his arms, while walking. This is: **[1]**

   a) to balance the effect of earth's gravity
   b) to keep constant velocity
   c) to increase the velocity
   d) to ease the tension

3. Which of the following quantities does not depend upon the orbital radius of the satellite? **[1]**

   a) $\frac{T}{R}$
   b) $\frac{T^2}{R^3}$
   c) $\frac{T^2}{R^2}$
   d) $\frac{T^2}{R}$

4. An object in the shape of a thin ring has radius 'a' and mass M. A uniform sphere with mass m and radius R is placed with its center at a distance x to the right of the center of the ring, along a line through the center of the ring, and perpendicular to its plane. What is the gravitational force that the sphere exerts on the ring-shaped object? **[1]**

   a) $\frac{\mathrm{GMm}}{\left(\mathrm{a}^2+\mathrm{x}^2\right)^{\frac{3}{2}}}$
   b) $\frac{\mathrm{GMmx}}{\left(\mathrm{a}^2+\mathrm{x}^2\right)^{\frac{3}{2}}}$
   c) $\frac{\mathrm{GMmx}}{\left(\mathrm{a}^2+2\mathrm{x}^2\right)^{\frac{3}{2}}}$
   d) $\frac{\mathrm{Gmx}}{\left(\mathrm{a}^2+\mathrm{x}^2\right)^{\frac{3}{2}}}$

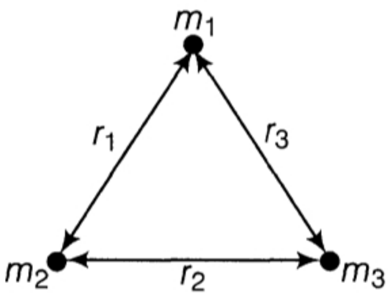
5. The velocity of the planet when it is closest to sun is **[1]**

   a) Zero
   b) can have any value
   c) minimum
   d) maximum

6. Two spheres of masses m and M are situated in air and the gravitational force between them is F. The space around the masses is now filled with a liquid of specific gravity 3.
   The gravitational force will now be **[1]**

   a) $\frac{F}{3}$
   b) F
   c) $\frac{F}{9}$
   d) 3F

7. Gravitational potential energy of a system of particles as shown in the figure is **[1]**



a) $\frac{-Gm_1m_2}{r_1} - \frac{Gm_2m_3}{r_2} + \frac{Gm_1m_3}{r_3}$

b) $\frac{Gm_1m_2}{r_1} + \frac{Gm_2m_3}{r_2} - \frac{Gm_1m_3}{r_3}$

c) $\frac{Gm_1m_2}{r_1} + \frac{Gm_2m_3}{r_3} + \frac{Gm_1m_3}{r_3}$

d) $\left(\frac{-Gm_1m_2}{r_1}\right) + \left(\frac{-Gm_2m_3}{r_2}\right) + \left(\frac{-Gm_1m_3}{r_3}\right)$

8. A uniform, solid, 1000.0-kg sphere has a radius of 5.00 m. Find the gravitational force this sphere exerts on a 2.00-kg point mass placed at a distance of 2.50 m from the center of the sphere? **[1]**

a) 2.67×10^{-9} N

b) 2.47×10^{-9} N

c) 2.07×10^{-9} N

d) 2.27×10^{-9} N

9. A satellite revolves very near to the earth surface. Its speed should be around: **[1]**

a) 8 km/s

b) 2 km/s

c) 5 km/s

d) 11 km/s

10. Both earth and moon are subject to the gravitational force of the sun. As observed from the sun, the orbit of the moon **[1]**

a) will be elliptical

b) is not elliptical but will necessarily be a closed curve

c) deviates considerably from being elliptical due to influence of planets other than earth

d) will not be strictly elliptical because the total gravitational force on it is not central

11. Acceleration due to gravity: **[1]**

a) decreases from poles to equator

b) is maximum at the equator

c) decreases from equator to poles

d) is maximum at the centre of the earth

12. A planet has twice the density of earth but the acceleration due to gravity on its surface is exactly the same as on the surface of earth. Its radius in terms of radius of earth R will be **[1]**

a) $\frac{R}{2}$

b) $\frac{R}{4}$

c) $\frac{R}{8}$

d) $\frac{R}{3}$

13. For a planet having a mass equal to the mass of the earth, the radius is one-fourth of the radius of the earth. Then escape velocity for this planet will be: **[1]**

a) 5.6 km/sec

b) 11.2 km/sec

c) 22.4 km/sec

d) 44.8 km/sec

14. If the radius of earth decreases by 1% and its mass remains same, then the acceleration due to gravity. **[1]**

a) decreases by 2%

b) increases by 1%

c) decreases by 1%

d) increases by 2%

15. If the mass of the earth is doubled and its radius halved, then new acceleration due to the gravity g' is **[1]**

a) g'= 16g
b) g '= 4 g
c) g' = g
d) g' = 8g

16. The acceleration due to gravity at a depth d in terms of g(acceleration due to gravity) at radius of the earth R_E is **[1]**

a) $g(d) = g(1 - \frac{2d}{R_E})$
b) $g(d) = g(1 - \frac{d}{R_E})$
c) $g(d) = g(1 + \frac{d}{R_E})$
d) $g(d) = g(1 + \frac{d}{2R_E})$

17. Different points in the earth are at slightly different distances from the sun and hence experience different forces due to gravitation. For a rigid body, we know that if various forces act at various points in it, the resultant motion is as if a net force acts on the c.m. (centre of mass) causing translation and net torque at the c.m. causing rotation around an axis through the c.m. For the earth-sun system (approximating the earth as a uniform density sphere) **[1]**

a) the torque is zero
b) the torque causes the earth to spin
c) the rigid body result is not applicable since the earth is not even approximately a rigid body
d) the torque causes the earth to move around the sun

18. The maximum vertical distance through which a full dressed astronaut can jump on the earth is 0.5 m. Estimate the maximum vertical distance through which he can jump on the moon, which has a mean density $\frac{2}{3}$ rd that of the earth and radius one quarter that of the earth. **[1]**

a) 6m
b) 7.5 m
c) 1.5m
d) 3m

19. Two particles of equal mass go around a circle of radius R under the action of their mutual gravitational attraction. The speed v of each particle is: **[1]**

a) $\sqrt{\frac{4Gm}{R}}$
b) $\frac{1}{2}\sqrt{\frac{Gm}{R}}$
c) $\sqrt{\frac{Gm}{R}}$
d) $\frac{1}{2R}\sqrt{\frac{1}{Gm}}$

20. A satellite is moving on a circular path of radius r around the earth has a time period T. If its radius slightly increases by Δr, the change in its time period is: **[1]**

a) $\left(\frac{T}{r}\right)\Delta r$
b) $\frac{3}{2}\left(\frac{T}{r}\right)\Delta r$
c) $\frac{3}{2}\left(\frac{T^2}{r^2}\right)\Delta r$
d) $\frac{2}{3}\left(\frac{T}{r}\right)\Delta r$

21. The law of areas can be interprted as **[1]**

a) $\frac{\Delta A}{\Delta t} = \frac{L}{m}$
b) $\frac{\Delta A}{\Delta t} = \frac{1}{2}(r \times p)$
c) $\frac{\Delta A}{\Delta t} = \frac{2L}{m}$
d) $\frac{\Delta A}{\Delta t}$ = constant

22. If g be the acceleration due to gravity at the earth surface, then what will be the increase in potential energy if object of mass m is raised by its radius R? **[1]**

a) $\frac{1}{2}mgR$
b) 2 mgr
c) mgR
d) $\frac{1}{4}mgR$

23. A satellite is moving with a constant speed v in a circular orbit about the earth. An object of mass m is ejected from the satellite such that it just escapes from the gravitational pull of the earth. At the time of its ejection, the kinetic energy of the object is: **[1]**

a) $\frac{1}{3}mv^2$

b) mv^2

c) $\frac{1}{2}mv^2$

d) $\frac{2}{3}mv^2$

24. The ratio of the accelerations due to gravity at the bottom of a deep mine and that on the surface of the earth is $\frac{978}{980}$. Find the depth of the mine if the density of the earth is uniform throughout and the radius of the earth is 6300 km. **[1]**

a) 25.38 km

b) 90.9 km

c) 13.0 km

d) 12.86 km

25. If the earth stops rotating, the value of g at the equator: **[1]**

a) decreases

b) increases

c) can't say

d) no effect

26. The orbital velocity of a satellite orbiting near the surface of the earth is given by **[1]**

a) v = $\sqrt{gR_e}$, where g = $\frac{GM_e}{R_e^2}$

b) v = $\sqrt{\frac{gh}{R_e}}$ where g = $\frac{GM_e}{R_e^2}$

c) v = $\sqrt{gR_e}$, where g = $\frac{GM_e}{R_e^2}$

d) v = $\sqrt{gh}$ where g = $\frac{GM_e}{R_e^2}$

27. Two satellites of masses M_1 and M_2 are revolving around the earth in circular orbits of radii r_1 and r_2. The ratio of their speeds $\frac{v_1}{v_2}$ is: **[1]**

a) $\sqrt{\frac{r_2}{r_1}}$

b) $\frac{r_1}{r_2}$

c) $\sqrt{\frac{r_1}{r_2}}$

d) $\frac{r_2}{r_1}$

28. The escape velocity on a planet is v. If the radius of the planet contracts to $\frac{1}{4}$th of present value without any change in its mass, the escape velocity will be: **[1]**

a) halved

b) doubled

c) quadrupled

d) one-fourth

29. An astronaut is standing on an asteroid when he accidentally drops a wrench. He observes that the gravitational acceleration on the asteroid is 2.4 m/s^2. If he had thrown the wrench at an upward angle instead, he would have found the gravitational acceleration on the asteroid to be: **[1]**

a) less than 2.4 m/s^2

b) downward at 2.4 m/s^2

c) greater than 2.4 m/s^2

d) toward him at 2.4 m/s^2

30. The earth is assumed to be a sphere of radius R. A plateform is arranged at a height R from the surface of the earth. The escape velocity of a body from this platform is fv, where v is its escape velocity from the surface of the earth. The value of f is: **[1]**

a) $\frac{1}{3}$

b) $\sqrt{2}$

c) $\frac{1}{\sqrt{2}}$

d) $\frac{1}{2}$

31. The escape velocity from earth is v_{es}. A body is projected with velocity $2v_{es}$. With what constant velocity will it move in the interplanetary space? **[1]**

a) $\sqrt{3}v_{es}$

b) $\sqrt{5}v_{es}$

c) $3v_{es}$ d) v_{es}

32. Consider a spacecraft in an elliptical orbit around the earth. At the low point, or perigee, of its orbit, it is 400 km above the earth's surface; at the high point, or apogee, it is 4000 km above the earth's surface. Using conservation of energy, find the speed at perigee and the speed at apogee. **[1]**

a) 5510 m/s (apogee), 8430 m/s (perigee) b) 4510 m/s (apogee), 8430 m/s (perigee)

c) 3510 m/s (apogee), 7430 m/s (perigee) d) 5510 m/s (perigee), 8430 m/s (apogee)

33. A satellite moves in elliptical orbit about a planet. The maximum and minimum velocities of satellites are 3×10^4 m/s and 1×10^3 m/s respectively. What is the minimum distance of satellite from planet if maximum distance is 4×10^4 km? **[1]**

a) $\frac{4}{3} \times 10^3$ km b) 1×10^3 km

c) 3×10^3 km d) 4×10^3 km

34. The escape velocity of a sphere of mass m is given by (G = universal gravitational constant; M_e = Mass of the earth and R_e = Radius of the earth) **[1]**

a) $\sqrt{\frac{2GM_e}{R_e}}$ b) $\sqrt{\frac{GM_e}{R_e}}$

c) $\sqrt{\frac{2GM_e m}{R_e}}$ d) $\sqrt{\frac{2GM_e + R_e}{R_e}}$

35. The period of a planet around sun is 27 times that of earth. The ratio of radius of planet's orbit to the radius of earth's orbit is: **[1]**

a) 27 b) 4

c) 9 d) 64

36. The height at which the weight of a body becomes $\frac{1}{16}$th, its weight on the surface of earth (radius R), is: **[1]**

a) 3R b) 4R

c) 5R d) 15R

37. The acceleration due to gravity at the North Pole of Neptune is approximately 10.7 m/s^2. Neptune has a mass 1.0×10^{26} kg and radius 2.5×10^4 km and rotates once around its axis in about 16 h. What is the apparent weight of a 5.0-kg object at Neptune's equator? **[1]**

a) 51 N b) 52 N

c) 50 N d) 49 N

38. The orbital speed of Jupiter is: **[1]**

a) equal to the orbital speed of earth b) greater than the orbital speed of earth

c) proportional to distance from the earth d) less than the orbital speed of earth

39. The reading of a spring balance corresponds to 100 N while situated at the north pole and a body is kept on it. The weight recorded on the same scale if it is shifted to the equator (take, g = 10m/s^2 and radius of the earth, R = 6.4×10^3m) is: **[1]**

a) 106 N b) 97.66 N

c) 110 N d) 99.66 N

40. A particle of mass m is at the surface of the earth of radius R. It is lifted to a height h above the surface of the earth. The gain in gravitational potential energy of the particle is **[1]**

a) Both $\frac{mgh}{\left(1+\frac{h}{R}\right)}$ and $\frac{mghR}{(R+h)}$

b) $\frac{mgh}{\left(1+\frac{h}{R}\right)}$

c) $\frac{mghR}{(R+h)}$

d) $\frac{mgh}{\left(1-\frac{h}{R}\right)}$

41. In our solar system, the inter-planetary region has chunks of matter (much smaller in size compared to planets) called asteroids. They **[1]**

a) will move in orbits like planets and obey Kepler's laws

b) will move in an irregular way because of their small masses and will drift away into outer space.

c) will move around the sun in closed orbits but not obey Kepler's laws.

d) will not move around the sun since they have very small masses compared to sun.

42. For a satellite to be in a circular orbit 780 km above the surface of the earth, what is the period of the orbit (in hours)? **[1]**

a) 1.98 hr

b) 1.65 hr

c) 1.78 hr

d) 1.88 hr

43. An object is thrown from the surface of the moon. The escape speed for the object is **[1]**

a) $\sqrt{2g'R_m}$ where g' = acceleration due to gravity on the moon and R_m = radius of the moon

b) $\sqrt{2g'R_e}$, where g' = acceleration due to gravity on the moon and R_e = radius of the earth

c) $\sqrt{2gR_m}$, where g = acceleration due to gravity on the earth and R_m = radius of the moon

d) $\sqrt{4gR_m}$, where g = acceleration due to gravity on the earth and R_m = radius of the moon

44. The asteroid Toro has a radius of about 5.0 km. Assuming that the density of Toro is the same as that of the earth (5.5 g/cm3) find its total mass and find the acceleration due to gravity at its surface. Mass of the earth = 6.0×10^{24} kg; radius of the earth = 6.4×10^6 m; G = 6.67×10^{-11} N m^2 kg^{-2}. **[1]**

a) 2.7×10^{15} kg, 0.0077 m/s^2

b) 3.1×10^{15} kg, 0.0077 m/s^2

c) 2.5×10^{15} kg, 0.0077 m/s^2

d) 2.9×10^{15} kg, 0.0077 m/s^2

45. An artificial satellite moving in a circular orbit around the earth has a total (kinetic + potential) energy E_0. Its potential energy is **[1]**

a) E_0

b) 2 E_0

c) 1.5 E_0

d) -E_0

46. If the gravitation force on body 1 due to 2 is given by $\overrightarrow{F_{12}}$ and on body 2 due to 1 is given as $\overrightarrow{F_{21}}$, then **[1]**

a) $\overrightarrow{F_{12}} = -\overrightarrow{F_{21}}$

b) $\overrightarrow{F_{12}} = \frac{\mathbf{F}_{21}}{2}$

c) $\overrightarrow{F_{12}} = \overrightarrow{F_{21}}$

d) $\overrightarrow{F_{12}} = \frac{\mathbf{F}_{21}}{4}$

47. If the mass of earth is 80 times of that of moon and its diameter is double that of moon and g on earth is 98 **[1]**

m/sec^2, then the value of g on moon is:

a) 9.8 m/s^2 b) 0.98 m/s^2

c) 4.9 m/s^2 d) 0.49 m/s^2

48. If g is the acceleration due to gravity at the surface of the earth. The force acting on the particle of mass m placed at the surface is **[1]**

a) Both mg and $\frac{GmM_e}{R_e^2}$ b) Data insufficient

c) $\frac{GmM_e}{R_e^2}$ d) mg

49. For a satellite moving in an orbit around the earth, the ratio of kinetic energy to potential energy is: **[1]**

a) $\frac{1}{\sqrt{2}}$ b) 2

c) $\sqrt{2}$ d) $\frac{1}{2}$

50. The acceleration due to gravity at a height 1 km above the earth is the same as at a depth d below the surface of earth. Then: **[1]**

a) d = $\frac{1}{2}$km b) d = 1 km

c) d = 2 km d) d = $\frac{3}{2}$km

51. Two satellites P and Q are in the same circular orbit round the earth. The mass of P is greater than that Q. It follows that: **[1]**

a) the speed of P is equal to that of Q b) the speed of P is greater than that of Q

c) the speed of P is less than that of Q d) the kinetic energy of P is equal to that of Q

52. The maximum and minimum distances of a comet from the Sun are 8×10^{12} m and 1.6×10^{12} m. If its velocity when nearest to the Sun is 60 ms^{-1}, be its velocity in ms^{-1} when it is farthest? **[1]**

a) 6 b) 60

c) 12 d) 112

53. If the position of the spheres approximates two uniformly dense rings, which of the following is the concerning a mass placed at position D? **[1]**

i. The net gravitational force due to the spheres of the larger ring would be zero.
ii. The net gravitational force due to the spheres of the smaller ring would be zero.
iii. The net gravitational force due to the spheres of the both rings would be zero.
iv. If the smaller ring were removed, the mass would move towards the centre of the larger ring.

a) Option iv b) Option iii

c) Option ii d) Option i

54. The area ΔA swept out by a planet of mass m in time interval Δt is related to the angular momentum by: **[1]**

a) $\Delta A/\Delta$t =$gL/(2m)$ b) $\Delta A/\Delta$t = $2L/m$

c) $\Delta\mathbf{A}/\Delta$t = $GL/(2m)$ d) $\Delta A/\Delta$t = $L/(2m)$

55. A satellite of the earth is revolving in a circular orbit with a uniform speed v. If the gravitational force suddenly disappears, the satellite will: **[1]**

a) move with a velocity v tangentially to the original orbit

b) fall down with increasing velocity

c) ultimately come to rest, som ew here on the original orbit

d) continue to move with velocity v along the original orbit

56. Two planets of radii r_1 and r_2 are made from the same material. The ratio of the acceleration of gravity $\frac{g_1}{g_2}$ at the surfaces of the planets is: **[1]**

a) $\frac{r_2}{r_1}$

b) $\frac{r_1}{r_2}$

c) $(\frac{r_2}{r_1})^2$

d) $(\frac{r_1}{r_2})^2$

57. The acceleration due to gravity at the North Pole of Neptune is approximately 10.7 m/s^2. Neptune has a mass 1.0 $\times 10^{26}$ kg and radius 2.5 $\times 10^4$ km and rotates once around its axis in about 16 h. What is the gravitational force on a 5.0-kg object at the north pole of Neptune? **[1]**

a) 53.5 N

b) 55.8 N

c) 54.5 N

d) 56 N

58. The required kinetic energy of an object of mass m, so that it may escape, will be: **[1]**

a) $\frac{1}{4}$mgR

b) 2 mgR

c) mgR

d) $\frac{1}{2}$mgR

59. What is not conserved in the case of celestial bodies revolving around sun? **[1]**

a) linear momentum

b) kinetic energy

c) angular momentum

d) mass

60. In Cavendish’s experiment: **[1]**

a) net torque on bar AB having two small lead spheres due to gravitational forces is positive

b) the net force on bar AB having two small lead spheres due to gravitational forces is positive

c) torque on bar AB having two small lead spheres due to gravitational forces is balanced by the restoring torque of the wire

d) the net force on bar AB having two small lead spheres due to gravitational forces is negative

61. Derive an expression for the work required to move an Earth satellite of mass m from a circular orbit of radius 2 R_E to one of radius 3 R_E. **[1]**

a) $\frac{GM_E}{12R_E}$

b) $\frac{GM_Em}{12RE}$

c) $\frac{GM_Em}{24R_E}$

d) $\frac{Gm}{24R_E}$

62. Kepler's second law is based on: **[1]**

a) Newton's first law

b) Newton's second law

c) Conservation of angular momentum

d) Special theory of relativity

63. The distances of two planets from the sun are 10^{13} m and 10^{12}m respectively. The ratio of time periods of the planets is: **[1]**

a) 10

b) $\sqrt{10}$

c) $\frac{1}{\sqrt{10}}$ d) $10\sqrt{10}$

64. A satellite in a circular orbit of radius R has a period of 4 h. Another satellite with orbital radius 3 R round the same planet will have a period I in hours: **[1]**

a) $4\sqrt{8}$ b) $4\sqrt{27}$

c) 16 d) 4

65. The change in the gravitational potential energy when a body of mass m is raised to a height nR above the surface of the earth is (here R is the radius of the earth) **[1]**

a) nmgR b) $\frac{mgR}{n}$

c) $\left(\frac{n}{n-1}\right) mgR$ d) $\left(\frac{n}{n+1}\right) mgR$

66. A missile is launched with a velocity less than escape velocity. The sum of its kinetic and potential energies is: **[1]**

a) negative b) first zero then negative

c) zero d) positive

67. The acceleration due to gravity at a height h in terms of mass of earth M_E, radius of the earth R_E and **gravitational** constant G is **[1]**

a) $g(h) = \frac{M_E}{(R_E+h)^2}$ b) $g(h) = \frac{GM_E}{(R_E+2h)^2}$

c) $g(h) = \frac{GmM_E}{(R_E+h)^2}$ d) $g(h) = \frac{GM_E}{(R_E+h)^2}$

68. Gravitational force is the smallest between **[1]**

a) earth and the moon b) earth and the sun

c) two pens weighing 100 gm at a distance of 0.4 m d) two books of weight 1kg each at a distance of 1 m

69. Consider a spacecraft in an elliptical orbit around the earth. At the low point, or perigee, of its orbit, it is 400 km above the earth's surface; at the high point, or apogee, it is 4000 km above the earth's surface. Using conservation of energy, find the speed at perigee and the speed at apogee. It is necessary to have the spacecraft escape from the earth completely. **[1]**

a) 9840 m/sec(perigee),9760 m/sec(apogee) b) 7840 m/sec(perigee),5760 m/sec(apogee)

c) 10840 m/sec(perigee),8760 m/sec(apogee) d) 8840 m/sec(perigee),6760 m/sec(apogee)

70. Two spheres of same size, one of mass 2 kg and another of mass 4 kg are dropped simultaneously from the top of Qutab Minar (height = 72 km). When they are 1 m above the ground, the two spheres have the same: **[1]**

a) potential energy b) momentum

c) kinetic energy d) acceleration

71. The escape velocity of a body, when projected from the earth's surface is 11.2 km s^{-1}. If it is projected at an angle of 60° with the horizontal, then escape velocity will be: **[1]**

a) 12.8 km s^{-1} b) 16.2 km s^{-1}

c) 11.6 km s^{-1} d) 11.2 km s^{-1}

72. The time period of a satellite is related to the density of earth (ρ) as: **[1]**

a) ρ

b) $\rho^{\frac{1}{2}}$

c) $\rho^{\frac{-1}{2}}$

d) $\rho^{\frac{-3}{2}}$

73. A particle of mass m is thrown upwards from the surface of the earth, with a velocity u. The mass and the radius of the earth are, respectively, M and R. G is gravitational constant and g is the acceleration due to gravity on the surface of the earth. The minimum value of u so that the particle does not return to earth is: **[1]**

a) $\sqrt{\frac{2GM}{R}}$

b) $\sqrt{\frac{2GM}{R^2}}$

c) $\sqrt{\frac{2gM}{R^2}}$

d) $\sqrt{2gR^2}$

74. Two satellites A and B have ratio of masses 3 : 1 in circular orbits of radii r and 4r. The ratio of total mechanical energy of A to B is: **[1]**

a) 12 : 1

b) 1 : 3

c) 3 : 4

d) 3 : 1

75. Black hole is: **[1]**

a) super surface of atmosphere

b) dense planetary material

c) super dense planetary material

d) ozone layer